

## HUMAN EXPLORATION MISSION STUDIES

Robert L. Cataldo  
NASA Lewis Research Center  
Cleveland, Ohio

The nation's efforts "to expand human presence and activity beyond Earth orbit into the solar system" was given renewed emphasis in January of 1988 when the Presidential Directive on National Space Policy was signed into effect. The expansion of human presence into the solar system has particular significance, in that it defines long-range goals for NASA's future missions. To embark and achieve such ambitious ventures is a significant undertaking, particularly compared to past space activities.

Two major efforts recently released, the National Commission on Space report, "Pioneering the Space Frontier," 1986, and astronaut Dr. Sally Ride's task force report, "Leadership and America's Future in Space," 1987, have helped set goals and give focus to NASA's future direction. Dr. Ride's task force formulated a plan to achieve the Commission's proposed agenda for the civilian space program. The task force recommended four initiatives: (1) Mission to Planet Earth, (2) Exploration of the Solar System, (3) Outpost on the Moon, and (4) Humans to Mars. The first two initiatives, to a great degree, are being pursued by NASA's Office of Space Science and Applications. However, the last two initiatives prompted the task force to recommend that a special NASA office be established to coordinate and lead human exploration studies. Therefore, the Office of Exploration was established to provide a focal point for these activities. These include establishing a mature understanding of mission options and opportunities and defining those near-term activities that can provide the greatest impact on future missions.

The Office of Exploration has established a process whereby all NASA field centers and other NASA Headquarters offices participate in the formulation and analysis of a wide range of mission strategies. These strategies were manifested into specific scenarios or candidate case studies. The case studies provided a systematic approach into analyzing each mission element. First, each case study must address several major themes and rationale including: national pride and international prestige, advancement of scientific knowledge, a catalyst for technology, economic benefits, space enterprise, international cooperation, and education and excellence. Second, the set of candidate case studies are formulated to encompass the technology requirement limits in the life sciences, launch capabilities, space transfer, automation and robotics in space operations, power, and propulsion.

The first set of reference case studies identify three major strategies: (1) human expeditions, (2) science outposts, and (3) evolutionary expansion. During the past year, four case studies were examined to explore these strategies. The expeditionary missions include the Human Expedition to Phobos and Human Expedition to Mars case studies. The Lunar Observatory and Lunar Outpost to Early Mars Evolution case studies examined the later two strategies. This set of case studies established the framework to perform detailed mission analysis and system engineering to define a host of concepts and requirements for various space systems and advanced technologies. This paper describes the details of each mission and, specifically, the results affecting the advanced technologies required to accomplish each mission scenario.